

What is claimed is:

1. A fused polycrystalline material comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ , wherein at least a portion of the  $\text{Al}_2\text{O}_3$  is transitional  $\text{Al}_2\text{O}_3$ , and wherein at least a portion of the  
5  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  are present as a complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .
2. The fused polycrystalline material according to claim 1, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  exhibits a garnet crystal structure.
- 10 3. The fused polycrystalline material according to claim 1, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  exhibits a perovskite crystal structure.
4. The fused polycrystalline material according to claim 1, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  exhibits a microstructure comprising dendritic crystals.  
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5. The fused polycrystalline material according to claim 4, wherein the dendritic crystals have an average size of less than 2 micrometers.
6. The fused polycrystalline material according to claim 1 comprising at least  
20 50 percent by weight of the  $\text{Al}_2\text{O}_3$ .
7. The fused polycrystalline material according to claim 6, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a garnet crystal structure.
- 25 8. The fused polycrystalline material according to claim 6, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a perovskite crystal structure.
9. The fused polycrystalline material according to claim 6, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  exhibits a microstructure comprising dendritic crystals.  
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10. The fused polycrystalline material according to claim 9, wherein the dendritic crystals have an average size of less than 2 micrometers.

11. A fused polycrystalline particle comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ , wherein at least a portion of the  $\text{Al}_2\text{O}_3$  is transitional  $\text{Al}_2\text{O}_3$ , and wherein at least a portion of the  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  are present as a complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ .

12. The fused polycrystalline particle according to claim 11, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a garnet crystal structure.

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13. The fused polycrystalline particle according to claim 11, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a perovskite crystal structure.

14. The fused polycrystalline particle according to claim 1, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  exhibits a microstructure comprising dendritic crystals.

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15. A plurality of fused polycrystalline particles according to claim 11.

16. The plurality of fused polycrystalline particles according to claim 15 comprising at least 50 percent by weight of the  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective particle.

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17. A plurality of particles having a specified nominal grade, wherein at least a portion of the plurality of particles are particles according to claim 16.

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18. The plurality of particles having a specified nominal grade according to claim 17, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a garnet crystal structure.

19. The plurality of particles having a specified nominal grade according to claim 17, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a perovskite crystal structure.

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20. The plurality of particles having a specified nominal grade according to claim 17, wherein the complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ , exhibits a microstructure comprising dendritic crystals.

5 21. The plurality of particles having a specified nominal grade according to claim 20, wherein the dendritic crystals have an average size of less than 2 micrometers.

22. The plurality of particles having a specified nominal grade according to claim 17, wherein the specified nominal grade is at least one of an ANSI, FEPA, or JIS  
10 standard.

23. The plurality of fused polycrystalline particles according to claim 16 comprising at least 75 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline particle.  
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24. The plurality of fused polycrystalline particles according to claim 16 comprising at least 85 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline particle.

20 25. The plurality of fused polycrystalline particles according to claim 16 comprising, by weight, the  $\text{Al}_2\text{O}_3$  in a range from 40 to 90 percent by weight and the  $\text{Y}_2\text{O}_3$  in a range from 60 to 10 percent by weight, based on the total weight of the respective fused polycrystalline particle.

25 26. A fused polycrystalline material comprising (a) alpha alumina having an average crystallite size in a range from 1 to 10 micrometers, and (b) complex  $\text{Y}_2\text{O}_3$ -metal oxide present as a distinct crystalline phase.

27. The fused polycrystalline material according to claim 26 comprising at least  
30 50 percent by weight of the  $\text{Al}_2\text{O}_3$ .

28. A method of making fused polycrystalline material, the method comprising:  
heating a fused polycrystalline material comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ , wherein at  
least a portion of the  $\text{Al}_2\text{O}_3$  is transitional  $\text{Al}_2\text{O}_3$ , and wherein at least a portion of the  
 $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  are present as a complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  to provide the fused polycrystalline  
5 material according to claim 26.

29. A method of making fused polycrystalline material according to claim 26,  
the method comprising:  
providing a melt comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ ;  
10 cooling the melt to directly provide the fused polycrystalline material.

30. A fused polycrystalline abrasive particle comprising (a) alpha alumina  
having an average crystallite size in a range from 1 to 10 micrometers, and (b) complex  
 $\text{Y}_2\text{O}_3$ -metal oxide present as a distinct crystalline phase.

31. A plurality of fused polycrystalline abrasive particles according to claim 30.

32. A plurality of abrasive particles having a specified nominal grade, wherein  
at least a portion of the plurality of abrasive particles are fused polycrystalline abrasive  
20 particles according to claim 31.

33. The plurality of abrasive particles according to claim 32, wherein at least a  
portion of the plurality of fused polycrystalline abrasive particles have an average  
crystallite size in a range from 1 to 8 micrometers.

34. The plurality of abrasive particles according to claim 32, wherein at least a  
portion of the plurality of fused polycrystalline abrasive particles have an average  
crystallite size in a range from 1 to 5 micrometers.

35. The plurality of abrasive particles according to claim 32, wherein at least a  
portion of the plurality of fused polycrystalline abrasive particles comprise at least 50

percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

36. The plurality of abrasive particles according to claim 32, wherein at least a  
5 portion of the plurality of fused polycrystalline abrasive particles comprise at least 75 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

37. The plurality of abrasive particles according to claim 32, wherein at least a  
10 portion of the plurality of fused polycrystalline abrasive particles comprise at least 85 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

38. The plurality of abrasive particles according to claim 32, wherein at least a  
15 portion of the plurality of fused polycrystalline abrasive particles comprise, by weight, the  $\text{Al}_2\text{O}_3$  in a range from 40 to 90 percent by weight and the  $\text{Y}_2\text{O}_3$  in a range from 60 to 10 percent by weight, based on the total weight of the respective fused polycrystalline abrasive particle.

39. The plurality of abrasive particles according to claim 32, wherein the  
20 specified nominal grade is at least one of an ANSI, FEPA, or JIS standard.

40. The plurality of fused polycrystalline abrasive particles according to claim  
31 comprising at least 50 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the  
25 respective fused polycrystalline abrasive particle.

41. The plurality of fused polycrystalline abrasive particles according to claim  
31 comprising at least 75 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the  
respective fused polycrystalline abrasive particle.

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42. The plurality of fused polycrystalline abrasive particles according to claim 31 comprising at least 85 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

5 43. The plurality of fused polycrystalline abrasive particles according to claim 31 comprising, by weight, the  $\text{Al}_2\text{O}_3$  in a range from 40 to 90 percent by weight and the  $\text{Y}_2\text{O}_3$  in a range from 60 to 10 percent by weight, based on the total weight of the respective fused polycrystalline abrasive particle.

10 44. An abrasive article comprising binder and abrasive particles, wherein at least a portion of the abrasive particles are fused polycrystalline abrasive particles according to claim 31.

15 45. The abrasive article according to claim 44, wherein the abrasive article is selected from the group consisting of a bonded abrasive article, a coated abrasive article, and a non-woven abrasive article.

20 46. The abrasive article according to claim 44, wherein the fused polycrystalline abrasive particles comprise at least 75 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

25 47. The abrasive article according to claim 44, wherein the fused polycrystalline abrasive particles comprise at least 85 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline-based abrasive particle.

30 48. The abrasive article according to claim 44, wherein the fused polycrystalline abrasive particles comprise, by weight, the  $\text{Al}_2\text{O}_3$  in a range from 40 to 90 percent by weight and the  $\text{Y}_2\text{O}_3$  in a range from 60 to 10 percent by weight, based on the total weight of the respective fused polycrystalline abrasive particle.

49. A method of making fused polycrystalline abrasive particles, the method comprising:

heating a plurality of fused polycrystalline particles comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ , wherein at least a portion of the  $\text{Al}_2\text{O}_3$  is transitional  $\text{Al}_2\text{O}_3$ , and wherein at least a portion of the  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  are present as a complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$  to provide the fused polycrystalline abrasive particles according to claim 31.

50. The method according to claim 49, wherein the fused polycrystalline abrasive particles comprise at least 75 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

51. The method according to claim 49, wherein the fused polycrystalline, abrasive particles comprise at least 85 percent by weight  $\text{Al}_2\text{O}_3$ , based on the total weight of the respective fused polycrystalline abrasive particle.

52. The method according to claim 49, wherein the fused polycrystalline abrasive particles comprise, by weight, the  $\text{Al}_2\text{O}_3$  in a range from 40 to 90 percent by weight and the  $\text{Y}_2\text{O}_3$  in a range from 60 to 10 percent by weight, based on the total weight of the respective fused polycrystalline abrasive particle.

53. A method of making fused polycrystalline abrasive particles according to claim 31, the method comprising:

providing a melt comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ ;

shaping the melt into precursor particles;

cooling the precursor particles to directly provide fused polycrystalline particles comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ , wherein at least a portion of the  $\text{Al}_2\text{O}_3$  is transitional  $\text{Al}_2\text{O}_3$ , and wherein at least a portion of the  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  are present as a complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ ; and

heating the fused polycrystalline particles comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  to provide the fused polycrystalline abrasive particles according to claim 31.

54. The method according to claim 53 further comprising grading the fused polycrystalline abrasive particles to provide a specified nominal grade including the fused polycrystalline abrasive particles.

5 55. A method of making fused polycrystalline abrasive particles, the method comprising:

providing a melt comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ ;

cooling the melt to provide fused polycrystalline material comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ , wherein at least a portion of the  $\text{Al}_2\text{O}_3$  is transitional  $\text{Al}_2\text{O}_3$ , and wherein at least a  
10 portion of the  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  are present as a complex  $\text{Al}_2\text{O}_3 \cdot \text{Y}_2\text{O}_3$ ;

crushing the fused polycrystalline material comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  to provide particles comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$ ; and

heating the particles to provide the fused polycrystalline abrasive particles according to claim 31.

15 56. The method according to claim 57 further comprising grading the fused polycrystalline abrasive particles to provide a specified nominal grade including the fused polycrystalline abrasive particles.

20 57. The method according to claim 57 further comprising grading the fused polycrystalline particles comprising  $\text{Al}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  prior to heating to provide a specified nominal.

58. A method of abrading a surface, the method comprising:

25 contacting at least one fused polycrystalline abrasive particle according to claim 26 with a surface of a workpiece; and

moving at least one of the fused polycrystalline abrasive particle or the contacted surface to abrade at least a portion of the surface with the fused polycrystalline abrasive particle.